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Modeling the structure of an oxide solar cell

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The article discusses numerical simulation of an oxide solar cell based on a Cu_2O/TiO_2 p–n heterojunction was carried out to optimize its structure and increase the efficiency of energy conversion. The influence of layer thicknesses, concentrations of acceptors and donors in Cu_2O and TiO_2 layers, as well as the work function of the back contact material on the photoelectric parameters of the solar cell is studied. It was found that the optimal thickness of Cu_2O and TiO_2 layers is 1.5 μm and 100 nm, respectively. It is shown that to obtain a high efficiency of a solar cell, the concentration of acceptors in the Cu_2O layer should be 10^{16} cm^{-3}, and the concentration of donors in the TiO_2 layer should be 10^{19} cm^{-3}. It has been found that the work function of the back contact material must be at least 4.9–5 eV in order to achieve high efficiency values. The most suitable contact materials for Cu_2O are Ni, C and Cu. For a solar cell based on a Cu_2O/TiO_2 p-n heterojunction, a maximum efficiency of 10.21 % was obtained (short circuit current density 9.89 mA/cm^2, open circuit voltage 1.38 V, fill factor 74.81 %). The results can be used in the development and formation of heterostructures of inexpensive oxide solar cells.

Keywords: solar cell, numerical modeling, layer thickness, donor concentration, acceptor concentration, back contact.

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